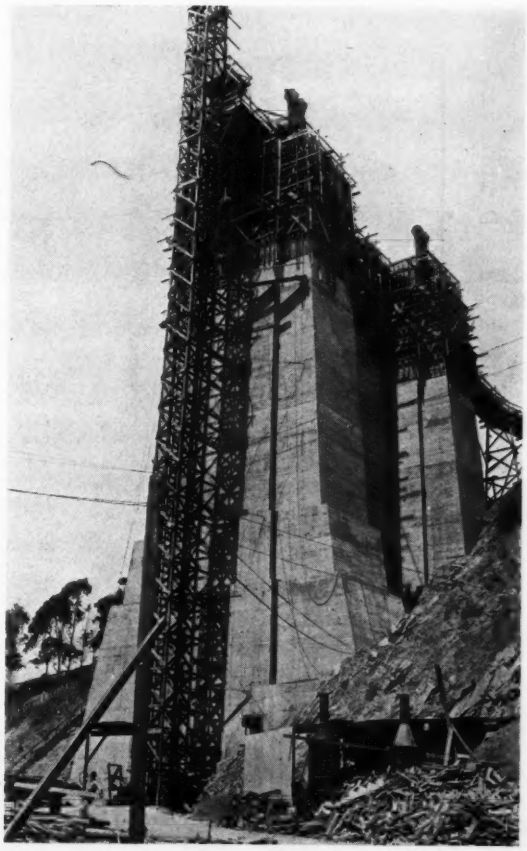
The CORNELL ENGINEER



Volume I JANUARY, 1936 Number 4

THE ENGINEER BECOMES SELF-CONSCIOUS

by C. F. Hirshfeld

POWER TRANSMISSION NEWS

"Early to bed, early to rise; work like hell and advertise." Some slogan, but the last word could well be changed to . . . modernize . . . or rather added to the phrase.

Modernization has already proved its value in many different ways . . . better merchandise and lower costs . . . surely both essential to business progress.

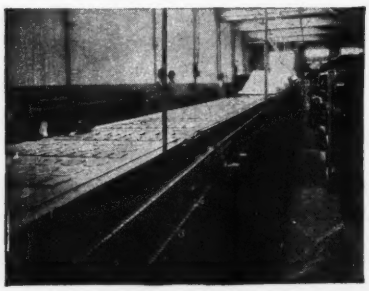
Investigation shows that Modernization can well begin with a study of the transmission of power, getting power where you need it at the lowest possible cost.

Producing means of power transmission the Morse Chain Company has been one of the leaders in helping manufacturers to modernize their factories and also apply modern power transmission to all forms of machinery.

Showing construction of Morse Standard Chain Coupling

Chain Drives both silent and roller have found a very definite place in the revamping of plant layouts. Experience has proved without question that chain drive transmits power with a minimum of loss, reduces costly breakdowns and really has more advantages than other forms of power transmissions. Reports of increased production at lower cost comes to us continually from customers who have installed chain drives as part of their modernization development.

Due to its flexibility and smoothness, as compared with other forms of positive



Morse Roller Chain used on Conveyor

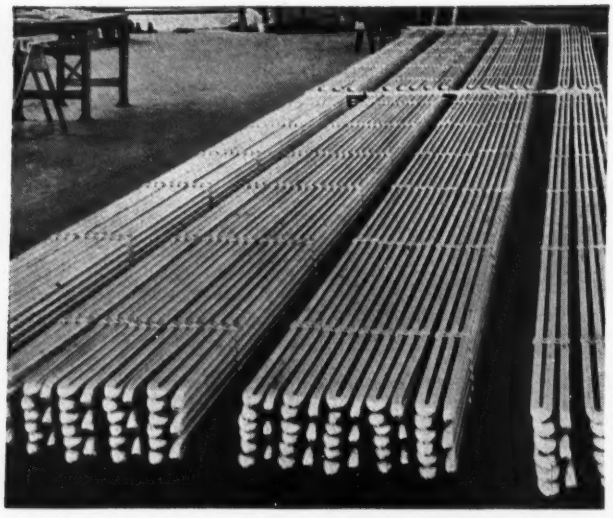
power transmission, the chain drive often permits operation of the driven unit at a higher rate of speed, thus further adding to the gain in production that results from absence of slip.

Furthermore, because of their adaptability to short centers, floor space is conserved, making more room available for other operations. They also eliminate overhead shafting and allow ceiling space to be used for conveying or other necessary functions.

Not only have MORSE Silent and Roller chains been used in many modernization plant developments, but other MORSE products have also taken their place in such plans. MORSE Flexible Couplings . . . the Morflex . . . using cold non-flow rubber as a flexing medium, and the standard MORSE Chain Coupling . . . are being used to correct misalignment and give better transmission through power shafts.

The MORSE Improved Kelpo free-wheeling clutch recently perfected by MORSE Chain Company is fitting into many plans for machine modernization.

MORSE sales engineers are located in the principal cities throughout the country and their services are available to all industries in the development of better power transmission.



SEVEN HUNDRED WELDS—were needed to make this assembly of aluminum piping.

New Metals Emphasize Desirability of Jointless Design

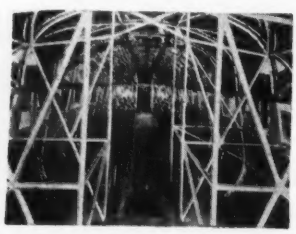
Welding Preferred Method for Fabricating Jointless Designs from New Materials

By H. E. ROCKEFELLER*

Welding is an important aid in securing the full benefit of the newer light weight alloys, corrosion- and stain-resistant steels and other ferrous and non-ferrous metals. Jointless welded designs in these new metals make the finished product attractive in appearance, efficient and economical to use and enable it to be priced salably.

In All Industries

Fabrication by welding can be undertaken without heavy capital expenditures and carried out at low cost. Welding is used in every industry for maintenance, for construction and for the fabrication of many products. The welding of mechanical refrigerators and gas ranges is typical of its production applications. Other typical applications include welding of chromium steel for resistance to sea water corrosion on seaplane pontoons, welding aluminum fuel tanks for airplanes, welding of the frame work of alloy steel on the new high speed railroad trains, welding of stainless steel beer barrels and innumerable other familiar products.



HERE'S HOW—the framework of the light weight, streamlined rail cars for high speed is Linde-welded from chrome-molybdenum steel tubing.

Welding is Simple Production Tool

Welding is the preferred method of fabricating almost every design in modern metals. Jointless welding can be done rapidly with a minimum of preparation of the pieces to be joined. Under procedure control providing jigs for positioning pieces, production can be as rapid and as free from rejections as any highly developed factory process. From the plant equipment standpoint it is easy to adopt welding. From the personnel standpoint the welding technique is quickly acquired through instruction by competent engineers.

For Jointless Strength and Safety

Products fabricated by welding are jointless, leakproof, permanent and safe. Improved methods of testing make it possible to tell exactly what stresses or loads a jointless welded assembly can take. Metals of different compositions, providing the most suitable material for the service it is to perform, can be welded into sound unified assemblies forever free from any of the losses which occur from joint failures.

Specialized Welding Assistance

To utilize the new alloys and metals fully, the advice of competent engineers in welded design is advisable. The Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, has for many years specialized in the development of new ways to use oxy-acetylene welding. Linde Engineers will gladly consult with you without obligation, and help you use welding and organize for welding production. This assistance can be secured by a telephone call to any Linde Sales Office. They are located at Atlanta — Baltimore, Birmingham, Boston, Buffalo, Butte—Chicago, Cleveland — Dallas, Denver, Detroit—El Paso—Houston—Indianapolis—Kansas City—Los Angeles—Memphis, Milwaukee, Minneapolis—New Orleans, New York—Philadelphia, Phoenix, Pittsburgh, Portland, Ore.—St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa.

IN JIG TIME—using jigs, welded joints can be made quickly in any commercial metal or alloy.

Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies—is available from Linde through producing plants and warehouse stocks in all industrial centers.

* Engineer, Development Section, The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

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Volume 1 JANUARY, 1936 Number 4

COMMENT

Dr. Hirshfeld writes an illuminating article on the Engineers' Council for Professional Development. He is especially well informed on this topic as he was Chairman of the Council from its organization until a short time ago.

* * *

A. W. Smith, one of Cornell's earliest graduates, presents a humorous sketch.

* * *

Our faculty article this month was written by Mr. Goodman who describes the recent developments in the Machine Tool Industry in non-technical language.

* * *

Mr. S. S. Wang, a graduate student in C.E., gives an interesting description of the necessity for light railways in China.

* * *

In an important message to its members President Stahl explains the reorganization of the Society of Cornell Engineers.

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—Courtesy of Warner & Swasey

THE CORNELL ENGINEER

Vol. I January, 1936 No. 4

The Engineer Becomes Self Conscious

By C. F. Hirshfeld, M.M.E. '05

A few short years ago the scientists and the engineers were being acclaimed as the saviours of mankind. The discoveries of the scientist when put to use by the engineer were hailed as leading us from an economy of scarcity to an economy of plenty.

And then came the depression; a period of widespread want in the midst of plenty. Instrumentalities of all sorts existed for the production of plenty but, for some reason, they were not utilized for that purpose. If utilized, their output could not be distributed. Almost immediately the engineer was accused of being mankind's worst enemy. The kaleidoscopic descent was breath taking to say the least.

The commentators must have been in error before or during the depression. If their appraisals were correct before this fateful period the engineer cannot be the arch enemy they would now have him appear. Or, if they are correct in their present appraisal they must have been very greatly in error a few years ago.

It is not the purpose of this article to attempt to weigh the arguments for and against and thus to arrive at a conclusion. In all probability no worth while conclusion could be obtained in this way. Certainly none which would satisfy the engineer could be reached by such methods because even cursory examination shows that most if not all these arguments are based largely upon superficial appearances and a prior reasoning rather than upon factual bases. The engineer cannot accept as proven the validity of conclusions not evidently resting solidly on fact.

It is, however, one of the purposes of this article to consider something rather closely related to the weighing of these arguments and the appraisal of the true value of the engineer to humanity. The discordant contentions have served to focus attention upon a very peculiar circumstance. Few of the authors and speakers who have attempted to evaluate the engineer and his works with respect to their social and economic significances have been engineers. They have come from almost every other class but largely from the ranks of sociologists and economists.

One may well ask why the engineer who has made these remarkable advances should be conspicuous by his absence from the ranks of those attempting to appraise them. There appear to be several reasons. For one, the engineer has been so well satisfied that his works were proper and timely that he has not thought it necessary to weigh their value. For another, he has been so engrossed in the doing of the engineering job that it has not often occurred to him to question whether the job was really worth doing from a long range sociological point of view. And, last but by no means least, few engineers have the training required for such evaluations even if they had the inclination and were willing to spend the time and energy required.

It seems probable that history will comment favorably upon the recent work of the engineer. But it seems equally probable that history will wonder how one engaged in an almost complete rebuilding of the material side of existence could have so long ignored the non-material aspects and consequences, the resultant social and economic problems.

A small number of engineers has come to believe it is now necessary that the engineer broaden the scope of his vision and thought so as to encompass these pregnant results of his activities. Acting in conjunction with others with different but equally sincere motivations they have been instrumental in procuring the organization of a new engineering body. It is known as Engineers' Council for Professional Development and will be referred to hereafter as E.C.P. D. or simply as the Council.

This Council is a joint agency of seven different organizations. They are:

American Society of Civil Engineers

American Institute of Mining and Metallurgical Engineers

The American Society of Mechanical Engineers

American Institute of Chemical Engineers

American Institute of Electrical Engineers

Society for the Promotion of Engineering Education

National Council of State Boards of Engineering Examiners

Five of these represent what may be called the professional and to some extent the social facets of the engineer's life. The sixth, the Society for the Promotion of Engineering Education, obviously represents the educational interests. The seventh, National Council of State Boards of Engineering Examiners, represents what may be called the legal aspect since this body consists of those authorized by law to pass upon the engineer's fitness to practice within the laws of the different states. Thus this new agency, E.C.P.D. is so constituted as to represent very completely the major interests involved in the preparation for the practice of engineering and the actual practice thereof.

The name of this Council indicates its purpose, namely the enhancement of the professional status of the engineer. To this end it considers ways, means and methods that are deemed usable and advisable and makes recommendations to its sponsor bodies. If these approve and so direct, E.C.P.D. becomes the agency for the execution of such programs.

There has been in some quarters a belief that E.C.P.D. was organized as a sort of professional labor union. This is far from the fact. It proposes that the engineer attempt to acquire greater recognition as a professional man by so broadening himself and thereby his influence, that such recognition will follow as a matter of course. It recognizes that the engineer has thus far confined himself so narrowly to the technical, to the public, incomprehensible, business of engineering, that that public has merely regarded him as a strange, close-mouthed sort of entity that went about its business in its own way and did not care to explain or to discuss. It recognizes that the engineer has lacked broad and intimate contact with humanity as a whole. This is thought to be due to the fact that his work does not naturally throw him into such contact as does that of the doctor of medicine, for example, and because he has not cultivated those mental avenues leading in that general direction. In short, E.C.P.D. stands on the belief that when the engineer has so broadened himself, his influence and his contacts as to warrant it, he will ipso facto receive professional recognition. It proposes to assist in the development of that sort of engineer.

How is that to be done? Are we to have a complete revision of engineering curricula to the end that engineering students may be given radically different training? Definitely no. This Council insists that an engineering education must impart a thorough knowledge of certain fundamentals, mathematics, sciences and applied sciences. It recognizes also that such education must impart a certain facility in the application to real problems of the things covered by these subjects. It believes also that when all this is done there is still room in a four years' engineering course to permit the inclusion of certain so-called cultural subjects. This term is used to cover such things as languages, history, social studies and economics.

But, E.C.P.D. states frankly that just as an engineering graduate is not really a competent engineer until he has added several years of practice to the education acquired in college, so also is he not a competent and broad professional man or even a competent citizen until he has augmented his knowledge of human affairs both by further study and by intimate contact with human beings, their thoughts and their actions.

It is therefore part of the program of E.C.P.D. to provide for self education after graduation. In this work it stresses the further acquisition of knowledge in both the technical and non-technical fields. Obviously no agency can make young engineering graduates apply themselves to such studies if they do not care to do so. All E.C.P.D. can do is to provide such guidance and assistance as feasible and then hope that those who have the vital spark will avail themselves of what is provided.

In the opinion of the author it is very necessary that there shall appear many young engineering graduates willing and able to subject themselves to the gruelling experience of serving their apprenticeship in the practice of engineering while they study several hours per day to broaden their mental horizons in non-technical as well as technical fields. We must have such non-technically trained technical men in large numbers to appraise and to interpret the works of the engineer and their social and economic significances. We must depend upon such men to assist in guiding future legislation into wise and consistent channels and prevent a continuance of a presently evident patchwork policy of expediency and assumption in dealing with such vital social affairs.

But E.C.P.D. does not propose to concern itself only with the man after graduation. It envisages broadly conceived programs applicable throughout the period which begins in preparatory school and ends with recognition as a fully fledged engineer. This body is already at work on tests which it it hoped will prove useful in determining the degree of natural aptitude for engineering. It is hoped that it may become possible to thus determine in advance whether a young man should enter upon the severe discipline of an engineering course or whether it would be better for him to expend his energies in other directions. The Council is also assisting in the establishment in different localities of local groups of educators and engineers who can advise young men and their parents with regard to engineering as a career. The general state of ignorance regarding what an engineer is, what he does and how he does it is almost unbelievable to the engineer. One must contact young men and their parents

and discuss the subject with them and appreciate the difficulty experienced in getting to them a correct impression, before one can realize how little general understanding there is of the engineering profession. After such experiences one ceases to wonder why the engineer, his works and his impersonal ideals are not properly appraised. One wonders how the engineer can have missed this point so long, how he can have continued to work in his highly technical pursuits without becoming aware of the fact that his fellow beings had no idea of what he was engaged in and of the tremendous potentialities thereof to themselves.

It is hoped that such programs as have been described and others may be instrumental in bring to our engineering schools the raw material out of which the broad gauge engineer visualized as the type needed in the future can be produced. It will then be the task of these schools to convert this raw material into the best possible product. Here also the Council hopes to be helpful.

For one thing, it hopes to be able to bring about greater cooperation between the educators, the practicing engineers and those who by law examine and license engineers to practice in the several states. It is believed that such intimate contact will assist engineering educators in the evolution of their methods and their curricula to the end that they may better fit men for practice. It is also hoped that it will bring to industrialists and others a better idea of what can be done and what cannot be done in a school of engineering. The result should be beneficial to all concerned and particularly to the student.

Some have expressed the fear that E.C.P.D. would undertake to dictate to engineering educators and to schools of engineering. It has even been suggested that this body might attempt to formulate and then to impose upon all engineering schools a set curriculum. Such fears are entirely unfounded. This Council has placed itself on record as recognizing that engineering educators must be left free to continue the development of educational methods and curricula as experience in education and the progress of engineering may dictate. In particular, it recognizes that any attempt to codify certain present standards or even to set absolute minimum standards would serve to throttle that which it is attempting to assist. The Council proposes rather to serve as a stimulus toward rational development and a nucleus about which this can occur. Arbitrary action is far from its concept of its function. Moreover, arbitrary action is in fact impossible because of the nature of the Council as a joint agency of several bodies including that representing the engineering educators.

Reference was made in earlier paragraphs to certain types of assistance it is proposed to render young engineering graduates. This did not cover all that is presently being done by the Council for these young men. One very interesting activity is the preparation and circulation of a Self Analysis Blank. This is so arranged as to enable a man, who is willing to be honest with himself, to develop and place before him for study a rather complete exposition of his good and bad points, his strength and his weaknesses.

In addition, it is hoped that there may be found in each section of the country representative engineers who are capable of advising men in their formative years and who are willing to take upon themselves such an additional burden for the good of the profession. The thought is that such men will then serve to listen to the trials and tribulations of the younger engineers, to appraise them in the process and to advise, encourage and correct as may appear necessary.

The Council recognizes that, for some time at least, men will enter the engineering profession through routes other than the schools of engineering. In an effort to serve such men and to assist them in growing toward the stature now pictured as the ideal, E.C.P.D. is setting up schemes and methods of guidance somewhat similar to those arranged for college graduates. In this case as in others, nothing of a compulsory nature is being attempted. It is up to each individual to determine whether he cares to avail himself of what is made available to him and, if so, to what extent.

Finally, the Council is attempting to bring a greater degree of order and coordination out of the many ways and means now in use for the recognition of engineers. A certain amount of explanation is necessary.

A majority of the states has already passed engineer registration or licensing laws and other states have such laws under discussion. These laws differ greatly among themeslves, both as to scope and content. The most severe apply to all individuals holding themselves forth as competent to practice engineering and require registration by a board which may insist upon thorough-going examinations if it deems such necessary. At the other extreme are laws requiring the registration of land surveyors only. In so far as these laws extend, they may be said to provide the only legally sanctioned methods of recognizing individuals as competent to practice negineering.

But, there are also other forms of recognition which are equally important and the operation of which tends to produce a rather confusing situation. For example, the different engineering societies establish certain criteria for admission to their different classes of membership respectively. These differ rather widely between the different societies and also differ from the criteria set up in the engineer registration laws of the different states.

Each society is certainly free to formulate and to enforce its own standards within the powers granted it by its articles of incorporation, just as each state is free to do so within such limitations as are set by its constitution and the constitution of the United States of America. Moreover, there is no basic reason why they must all dovetail in orderly fashion. But it is confusing, to say the least, to have these and other agencies all labelling people as

engineers and using quite different methods of appraisal and units of masure in the process.

Other professions, and notably the medical profession, have found it desirable to arrange things differently after a long experience with such anomalous conditions. It is the belief of E.C.P.D. that the time has now arrived when the engineering profession may well attempt to bring about greater definition and greater uniformity with respect to to the recognition of professional engineers. This is no small or easy task nor is it one that can be completed in a short time. The attempt will call for a large measure of devotion to an ideal, forbearance on the part of all and a wholehearted cooperation during a long period of adjustments and readjustments. If the ideal is attained at some time in the future much will have been done toward setting standards of ability, education and achievement of which the profession can be proud. And much will have been done toward clarifying the great public's picture of the engineer and his profession.

History In Reverse Gear

By A. W. Smith '78

On a front window in suburban New York was this sign:

J. Wellington Smith
Advice to Inventors—Patents Negotiated
9 to 12 A. M. — 2 to 4 P. M.

At a time of slack business Mr. Smith sat inside reading. Presently a maid opened a door and said:

"A man to see you."

"Show him in."

A well dressed man with eager face and fiery eyes entered and took a proffered chair. Speaking accurately and with a cultivated accent he began:

"I came to tell you confidentially of some of my great inventions. You know that students of history at present delve into dusty books on back shelves of dim libraries, seeking records of the past. Much that they find is not fact but fiction. All historical knowledge would be rendered more accurate if historians could look on events as they really occurred."

"Quite true" said Smith.

"My greatest invention," said the man, "Would place, just above the North Pole of the Earth and coaxial with it a large disc with mechanism and power for rotation at varying speed in either direction. A screen would surround the disc at its outer rim and upon the screen—by another of my inventions—could be made to appear events of earth's development with accompanying sounds. Seats for historians and others interested would be arranged upon the disc."

"How would you get to the pole with all this apparatus?" asked Smith.

"Another of my inventions answers your question. You know that physicists have discovered that the earth is constantly a recipient, from outer space, of waves of cosmic energy. My invention would collect a portion of these waves, condense them highly compressed into thermos bottles, where they could be held indefinitely. Opening and aiming one of these bottles would melt an iceberg almost instantly. Thus you see how a broad pathway could be melted straight to the pole. Moreover cosmic waves properly applied could supply energy to engines for transport and to rotate the disc.

"Now the rotation of the earth virtually has unwound history, and the disc with reversed rotation would wind it up again; and historians sitting on the disc could see and hear history occurring backward. This at high disc speed would take them promptly to the very beginning of man upon the earth. Then, if they objected to history backing up, the disc could be reversed and events could be run off rapidly right end to. Just think how interesting it would be to watch the centuries skidding past! If the historians wished to study details of certain periods, the operator could adjust speed to their needs.

"Beyond history epochs of the earth's evolution could be made to appear to geologists and biologists.

"Care would be nesessary not to overdo the reverse movement or the show might run into chaos, and there would be no telling what would happen then with the earth gasified with all in it. The disc operator would need to be a wise and careful man!

"But here is a possibility: If the disc were run forward—as the earth turns—wherever it might start, it would come eventually to the present; and, if motion continued the future would appear on the screen. Then prophets would lose their jobs. There would be no more uncertainty as to whether good or bad might befall; ambition would die. The more one thinks of results of a future universally known, the worse it seems. I think that it would be necessary to provide a stop on the disc mechanism to prevent its use beyond the present confining its use entirely to the past.

"Another invention—"

Here the telephone bell rang, and Smith stepped into a booth leaving the door ajar.

The Smith end of the telephone conversation follows:

"Hello!"

"Who?"

"Hospital for insane criminals?"

"Escaped!"

"Yes, I've seen him; he's in my office now."

"What? Yes, I'll try to hold him."

Smith turned; his visitor had faded away.

Machine Tools*

By H. L. Goodman, '26 M.E.
Instructor Experimental Engineering

Surprising as it may sound, this basic industry does not directly manufacture the great mass of machines and implements that we daily encounter. It is, however, concerned with the building of machines and instruments that construct all the machines and the implements that we use for our varied daily purposes. Dean Kimball here at Cornell has well summed up the Machine Tool business in the phrase, "The Master Tools of Industry." In these machines we can reduce castings and forgings to their ultimate dimensions quickly and accurately until it becomes difficult to detect variations in similarity of one successive piece from another. It is in this direction that the Industry becomes exceedingly interesting, for as FORTUNE points out, this is why Mr. Ford can take any one of his 16,000,000 pistons and fit it into any one of his 16,000,000 cylinders. Accuracies in certain lapping and honing operations can be obtained within 3/1,000,000th of one inch. So, broadly speaking, the Industry not only makes the bolts and the nuts but it also makes the wheels and makes the wheels go around.

The Machine Tool Industry is also interesting from its historical background. It has developed from one improvement leading to another, one man finds one way to do a job, another man discovering another way, so that competition within the industry has always been keen, making for constant improvement. Just stop and ask yourself the question, how was the first lead screw cut? Realizing the screw is one of the most important mechanical devices we have, how would you set about to develop a machine to make screws if you had no lead screw or one had never been made? This is why machine tools are so well termed the "Master Tools of Industry" because there is nothing behind the Machine Tool Industry, they make the machines that make the machines, that make the machines, etc.—you know.

This is one industry that we Americans can well be proud of for it is generally associated with Yankee ingenuity though its success is sometimes erroneously contributed to some of our foreign competitors. It might surprise you, however, to find the amount of foreign business that the Industry does. In terms of precision the common thought is that Germany, Switzerland, Japan are better but it is not true. Because foreign business, which represents something like a quarter to a third of American machine tool sales, depends especially upon the fact that the U. S. machine tool industry is universally admitted to be the world's finest. During the depression years some builders maintained a back log of activity by means of orders from those countries striving to build up their industrial self sufficiency, particularly Russia with her 5 year plan.

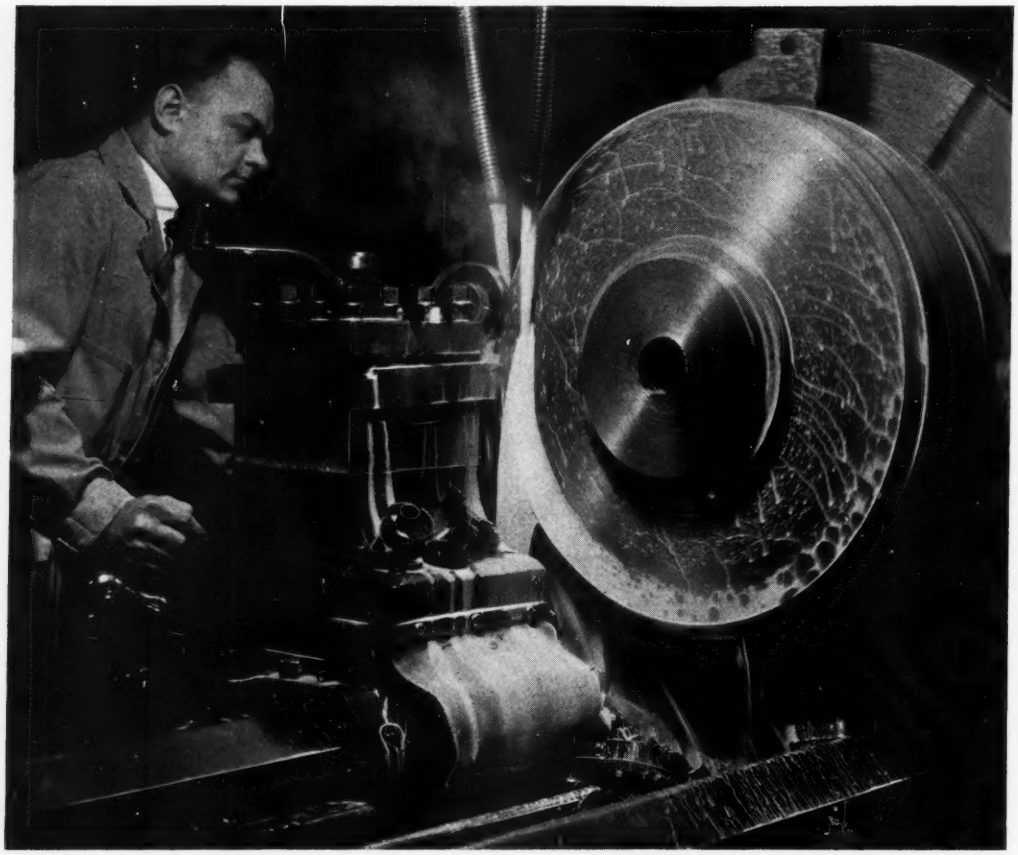
The Brown and Sharpe Company founded in Providence, R. I. in 1883 by Messrs. Brown and Sharpe has contributed a great many men to the Industry. It was here that many heads of later companies in the Industry served their apprenticeship. Thus the Industry developed around New England and has gradually moved west to Cleveland, Cincinnati, Rockford, Ill., etc.

The Industry does not loom large in the big Business picture. FORTUNE compares the entire Industry with one member of the Automotive Industry. It finds that in 1929 General Motors business was $1,500,000,000 while the total sales volume of the Machine Tool Industry was only $175,000,000 which, incidently, was the best year the industry ever had, but aside from the size the Industry is interesting now because it is receiving considerable press comment as an index of business recovery. One can point to the very salient fact that if corporations are buying these basic tools at the present rate, it is quite evident that they are not only replacing worn out or obsolete machines but plan for a general expansion in the number of automobiles, refrigerators, radios, etc. manufactured.

From FORTUNE we learn that for every $100 worth of business done in the entire year of 1934 the Industry is currently selling $120. The probable sales will exceed $100,000,000 for the year 1935 because some leading manufacturers have reported a constant gain from September with December the best month they have had. 1935 was 82% better than 1934, 329% better than 1932.

During the past depression there has been no other industry that has had to retrench as the Machine Tool Industry. Their sales dropped from a peak in 1929 to a low in 1932—to wit: $175,000,000 in 1929 to $20,000,000 in 1932. What is more serious, the employment dropped from 50,000 wage earners to the alarming figure of 12,000. Although the amount of business did not justify even this many, management made serious sacrifices to keep this nucleus together in order to be in a position to make machines if there ever should be a demand for them, at times a most discouraging hope. This today presents a real problem to the management of the Industry. Quite a percentage of this 38,000 unemployed sought and obtained employment in other fields, leaving the Industry about 40% undermanned. This is one of the contributing factors that is preventing the Industry from making a more startling recovery. For the Industry requires the highest type of skilled worker. Although

*This article has been prepared for those undergraduates and others who are not familiar with this basic Industry in order that they might appreciate some of the recent advances and to the former as a guide in selecting a field of interesting endeavor.—The Author.



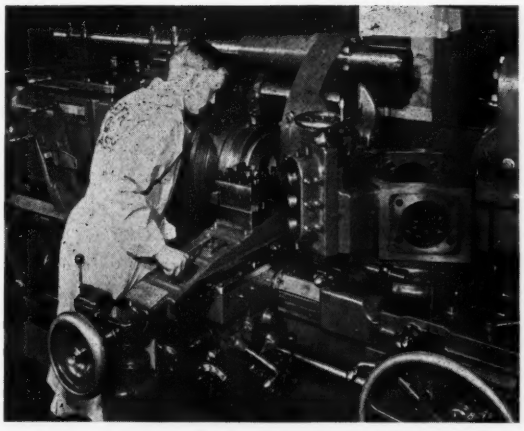
many attempts have been made to introduce mass production methods in the manufacture of these machine tools, they still stand as an example of individual mechanical genius.

During the depression years many manufacturers in this field turned their talents from the production of machines to the development of new models and new ideas, so that at the Machine Tool Show held in September there were on exhibition the finest tools that industry in general has ever had to work with. This means we are going to be able to produce more and better machines cheaper than ever before.

For, surprisingly enough, Mr. Ford cares not whether a Turret Lathe costs $10,000 or $20,000 (of course eliminating the competitor who would offer one from $8,000 to $18,000). He will buy for only two reasons: (1) that by buying such a machine he can save enough on each operation so that when multiplied by the number of operations he plans to make it will pay for the cost of the machine; (2) that by buying such a machine he can improve his product and make his competitors machines obsolete. Thus in a way machine tools sell themeslves, but don't be misled if there is a lot of "door-bell ringing" and a lot of planning and scheming to sell machine tools just as there is for anything else.

Although the automotive industry represents the best customer of the machine tool industry, a large volume of business is drawn from textiles, ordnance, and the electrical industry in general. It was the demand of the sewing machine, bicycle, and ordnance industries that gave the machine tool industry its initial impetus. It is not particularly important in ordnance that a gun carriage have two identical wheels, but it is rather important that the projectiles come somewhere near fitting the rifles. Likewise important is the fact that the cylinder action of a six shooter comes somewhere near synchronizing with the trigger. For these reasons machine tools have become somewhat associated with the manufacture of munitions and unquestionably some of the increase in the machine tool business is due to the current war scare in Europe.

As for the trends in the Machine Tool Industry, there are distinctly two. First, every designer has attempted and is attempting to transfer his own brains and ingenuity to his design in order to relieve the demand for skilled labor of which, as has already been pointed out, there is an extreme shortage. Of course this is complete in the full automatic machines. However, these are only economically justifiable in extreme mass production due to long set-up times and the first cost of the machines.



—Courtesy of Warner & Swasey

Second are two demands that are practically incompatible —namely the demand on the Machine Tool for the ultimate in precision, the enormously high pressures incident to the carbide cutting tools. Consequently designs have become more rugged and stresses have been greatly reduced, by increased cross sections, so that deformations within those limits can be so held as to maintain the desired accuracy. In using ordinary cast iron some of these sections become ridiculous in their proportions. Therefore there has been considerable trend toward the use of Nickle Cast Iron which gives about a 40% increase in the Modulus of Elasticity thereby helping to reduce these sections somewhat.

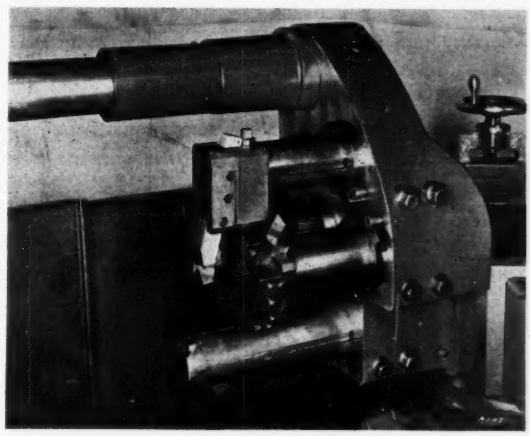
Before entering into a discussion of the different phases of the Industry and just what the individual operations are, one cannot help mentioning the management phase of the Industry. There are two outstanding traits here represented. First, these individual businesses have generally grown up around the founders and have been handed down to the successive generations so that family policy is reflected in each individual business. Although corporate in form, the majority stock is family held, thereby preserving company as well as family tradition. Second, expansion and development have been financed out of profits and the rule of keeping out of the bankers hands is almost universal thereby making the Machine Tool management a kind of aristocracy of U. S. management. It is due to the policy of owing no one money that this management is enabled to endure the serious ups and downs of its business.

Through the National Machine Tool Builders Association studies are being made to try to eliminate the serious swings inherent to the Industry and at some future date the Industry may be able to lease their respective Tools as one rents a Telephone or Shoe making machinery. In that manner old machines can be replaced during the depression of general business, tending to iron out the serious swings of their cycle. For it has been estimated that 75% of the machine tools in general Industry today are more than ten years old.

Now, as to what the Industry does most everyone knows but, as for a general survey, Machine Tools can be broken down into eight basic operations. The most important part of any machine tool is its cutting edge, for it is here that the metal is removed quickly and accurately. The original machine for doing this was the lathe. The other seven operations are somewhat a variation of this original process, to wit: Milling, Grinding, Planing, Broaching, Drilling, Honing and Lapping.

In Milling operations the work is stationary with respect to movable table on which it is held, contrasted with turning operations where the work is made to revolve. In Milling a series of cutting edges are caused to come into contact with the work. These cutting edges are mounted or integral with the circular cutter. As this cutter comes in contact with the work the table moves the work under the cutter thereby removing the metal. However in turning operation we deal with only one cutting edge except in Turret Lathe or Boring Mill practice where we may deal with a number of individual cutting edges, each with a separate purpose. (See Cut.)

In some turning operations the amount of over-hang is sufficient to make it difficult to hold the work rigidly



—Courtesy of Warner & Swasey

in a horizontal lathe, particularly without centers or steady rest. The answer was to turn the lathe up on end so that the action of gravity was parallel to the axis of the spindle of the lathe, hence we have the so called Boring Mills. Their use in the large is confined to heavy shapes impossible to handle in the Lathe.

There are of course variations of the horizontal milling described above which are particularly adapted to the accurate finishing of flat surfaces not necessarily large. For instance the construction of this typewriter that I hammer this out on depends upon milling operation to a large measure for its ultimate operating condition.

Probably the most important variation of the horizontal milling process is the end Mill, which is now being called a Die Sinking Mill. It is used to make dies and molds of complicated character such as the so called

(*Continued on page ninety-eight*)

The Necessity of Light Railways in China

By S. S. Wang, Grad. C.E.

When I served in the Reconstruction Bureau of Kiangsu provincial Government of China, I constructed hundreds of miles of highway. But my experience tells me that it is not the best means for the improvement of communication. Before the Tsing Dynasty, the highway system in China was very complete and excellent. Every province was required to build a good road leading to Peking, the capital of former China, for the delivery of documents and the contribution of the provincial tributes to the Imperial Government. The width of such a road varied from 5 to 200 feet. Twenty horses abreast could run quickly without congestion. The middle portion of 30 feet was paved with large bricks and block stones, while some of the royal highways were constructed of the beautiful marbles, the surface of which was so artificially arranged as to show different beautiful pictures. These interstate highways were well maintained by the respective provinces. At a distance of one hundred lis, which is about thirty miles, stations were established, and at tenth points between stations, sitting pavillions of different shapes were provided as places of refreshment for the passangers. But, when railroad was constructed, most parts of those highways were utilized as the roadbed of, or crossed by, the railroad. Therefore, a good system of highways was gradually obliterated.

At present, a serious condition has occurred in China, because the old system of highways has been destroyed, while the new system of railroads has not yet been completed. The communication throughout the whole country is broken. It is no doubt, that, in order materially to improve the civilization, we should develop the communication first. But there is a question: How can we improve it in the most economical way?

Since the founding of the Central Government of the Republic of China, many high officials have given their attentions to the construction of highways for the development of communication. It is, indeed, a sign of the revival of the nation. Now a big plan for this construction of highways is in progress. Since, owing to the financial embarrassment, the construction of cheap road is highly voiced in different provinces, most highways are constructed of earth road. The better pavement is the clay bound Macadam road. So far as my experience is concerned, the method of construction in most parts is not excellent. They compress the broken stone, not thoroughly compacted, and add too thick a layer of clay upon it. It may serve the purpose well in fine weather but spoils under heavy rain. When the thick layer of clay sheds down to the side ditches, a mosaic surface of stone appears. It is necessary to require an expensive renewal. However, generally, they only provided the first cost, never taking the cost of maintainance into account. After three or more years without repair, the road surface will become so bad that when you drive automobiles over it, you may feel very uncomfortable. Not only the driver and passengers suffer but also the engine is easily damaged. It is generally conceded that the profit gained from bus operation can scarcely support the cost of maintainance. It is therefore almost desolate after the service of ten years. So millions of dollars are invested in the wrong spot.

When more mileage of highways are constructed, more fuel, buses, and motor cars are to be imported from the foreign countries. Evidently the construction of highways is the key to open a large field of foreign trade and drain a great sum of national funds abroad. The national reconstruction of China may probably meet failure, if the economic project is not undertaken. The economic project must cover several factors so as to design the best means of communication with high efficiency and low cost; to keep the rate of transportation as low as possible; to render greater facility for the conveyance of agricultural and industrial products between the country and cities; and to make ample provisions for the future development. In one word, to invest a minimum amount of money for the maximum profits and services. Generally the cost of motor transportation is comparatively higher than that of the freight of a railroad. It is only suitable for short distances. It can only assist the deficiency of the railroad, and can never compete with the railroad.

In your country the motor industry is fully developed, it is advisable to construct more highways for the free development of private enterprise. But this is not applicable in China, as her financial condition in recent years is not favorable. It is better to use the money in a wise way, i.e., to apply the investments to such lines as are able to get the great profits immediately. If more highways are constructed, it can not relieve the distressed people, but only increase the heavy burden of taxes. It is a striking example that, although many highways have been constructed, there is no improvement of local industry and little convenience for the passengers. Because the fixed rate of bus passage is too high, most products and passengers are still carried by the boats and trains as usual. I believe that the policy of the construction of long highways must meet failure. Although the motor car which uses charcoal as fuel is in the experimental stage, yet the time of its practical usage may be far from the present.

But I don't reject the plan of highway construction. I don't mean that we should not construct them. I mean only at present it is more economical to construct the railroad, especially the light railroad. When we look over

China as a whole, we see that there are only a few railways constructed, not linking all provinces together. Because of the inconvenience of communication, many activities of political reforms, material improvements, and the exchange of civilization are suspended. There is no nation in the world, that is prosperous and powerful without the best means of communication. The construction of a railroad is indeed the first stepping stone to the development of an old nation, without which the materials civilization can never succeed. It is the best means to relieve famine, to suppress bandits, to terminate civil wars and to strengthen the national defense.

When you closely study the social, political, and industrial conditions of China at present you may realize the great need of light railway construction. In the first place, the population in China is not uniformly distributed but is too dense in cities and coastal provinces, while too sparce in the northwestern parts. It may result in a surplus of food in one part but scarcity in the other. In the second place, there are too many educated men and women in the eastern provinces, while too few in the western. In the third part, the policies of the Central Government can not be efficiently executed in different provinces. The disturbances of rebels or bandits can not be quickly suppressed. And, in the fourth place, the agricultural products and various manufactures can not be transported a great distance. So the rural and industrial depression become more serious. It is manifest that the best solution for such difficulties is to develop the communication as quick as possible. But, at present, a great sum of funds is not easily available. I think the traffic loading may not be heavy at the beginning. It is advisable to construct the light railway. The first cost may be small but its advantages are very great.

I highly advocate the construction of the light railway, because I believe that the promotion of such construction can certainly lead China to the progressive road. I hope the Central Government will concentrate its whole financial power to complete the net for her railway system. If it is impossible to accomplish it soon, a special privilege may be granted to those who will invest for such an enterprise. It may also open to the foreign investor opportunities under proper conditions so as to avoid a second case of the South Manchuria Railway. If a proper interest is accorded by the law to encourage them to invest in such public enterprise, there may be lots of bidders to apply for it. The progress of construction of the light railway with private capital may be more successful and rapid than by the governmental administration. This is really profitable to both parties. I think it is better to allow a free development of railroad by reliable stock companies. But the Ministry of Railways must exercise the full power to supervise them.

The light railway is, of course, a temporary structure. Some inferior materials may be used. All plans and equipment should be as simple as possible. It is better to use the standard guage. The weight of rail may be either 35 or 45 lbs. per yard, which may be easily manufactured by the Chinese Steel Company. The size of ties is 6 in. by 8 in. by 8 ft. The best quality of native timber, if once creosoted, may serve the purpose satisfactorily. Six inches of stone ballast under the tie may well sustain the traffic loading. The simplest type of block signalling may be advantageously used, because there is only a light traffic service at the beginning. The width of roadbed may 14 or 16 ft. The gradient may be excessive in the first construction, because it is not expensive in revision. The elevation of subgrade must be higher than the maximum water level, because of the floods occurring in China annually during recent years. Otherwise it may probably cause the suspension of traffic every year. In order to cut down the initial cost, it is advisable to purchase the minimum rolling stock. Locomotives of 250 H. P. with separate tender which can haul 250 tons of load on a 1% grade may be used. The carrying capacity of freight cars, both open and closed may be 15 tons. All cars and locomotives must be provided with air brakes and wheels with steel tires. The experience of the Hong-kiang Railway has shown that the approximate cost with the minimum rolling stock for 35 lb. rail is estimated at about 35,000 to 40,000 Mexican dollars per kilometer.

However, those parts of permanent nature should be strong, final, and capable of future extension. The alignment of the proposed railroad plays an important role in the cost of construction and also the prosperity of operation. It should be established with great care and conducted by well exercised engineers. The line must be so selected as to be satisfactory once and for all, because a slight relocation may waste a great sum of money. If the location is well selected, the roadbed may not be disturbed again. All bridges and culverts along the line preferably should be the permanent structures. They must provide an ample capacity to sustain a heavy traffic loading in future. Both steel and reinforced concrete works may be used with more advantage.

It is a wise policy to undertake the productive enterprise at first. Since China cannot collect a great sum at one time, and that sum if available, must demand a great profit in a short time, only the development of a light railway can satisfy this condition. Generally the light railway requires a less amount of money in first construction, and may gain a great income immediately, with which a further extension can be accomplished in turn. So the development of communication is thus hastened. When I observe the waste abundant of natural resources, the serious depression of rural economics, and the dangerous situation of a national crisis, I realize more the urgent need of a light railway. I hope more Chinese engineers will call greater attention to promote the construction of the light railway in China.

THE CORNELL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR

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EDITORIALS

ENGINEERING ATHLETICS

The College of Engineering evidently is not interested in inter-college athletics. Several attempts to form soccer teams have met with very little success. In fact in the C. E. School, at a special meeting called for those interested in playing for the C. E. School, only one man showed up. The other Engineering Schools are having the same difficulty. The obvious question seems to be whether or not the Engineering College wants to be represented in inter-college athletics.

The Engineering College has been outclassed lately by the other colleges in the University. This has been due partly to the low enrollment in the college as compared to other colleges in the University, partly to the lack of spirit shown by the students who are best able to play the game with the other colleges. Then again there are men who would play for their college rather than for their fraternity if it would be possible to get a fairly good group together for inter-college athletics.

During this drear period when it seems that all interest in school athletics has been on the wane, several forward looking individuals have formulated a logical and legitimate argument. The main theme of it is this: combine all the engineering schools, and compete against the larger colleges of the University as a College, rather than as individual schools. Thus C.E.'s, M.E.'s, E.E.'s, and A.E.'s would all be playing for the glory of the Engineering College, and not their individual schools.

Of course this thought of combine is not pleasing to a great many of us, because we have to hold back a bit of self-pride when we go into a thing with someone else. But, nevertheless, we should have the welfare of the college as a whole at heart, as much as that of an individual school. A combination of the engineering schools would be strong both offensively and defensively against the other colleges. All engineering colleges are having the same trouble, and a combination or merger for athletics would benefit all of us.

PAUSE AND REFLECT

The Seniors nonchalantly pass from class to class as they have been doing for three years apparently unaware that as the year progresses their undergraduate life is nearing an end. Yet within himself every man in the class notes with mixed feeling the passing of those things which make college life a well balanced whole. Perhaps he dares to pause and ask of himself "Have I made a success of my college career"?

The four years spent in college should be regarded as a job. Employers everywhere regard a man's record as an indication of just how well he has conducted himself on the job. Yet many students do not get this view-point until as Seniors or Graduates it is presented rather abruptly by the personnel department of some company.

As an underclassman you have a task before you, namely, to get as much out of college as you possibly can and it is never too late to start doing just that thing. A good scholarship record should be the primary aim of every student which combined with sufficient extracurricular activity produces a well rounded whole. The exact balance between the two is an individual matter but as a student you should never lose sight of the fact that this is your first big job. Will you succeed or will you fail?

CUTS

Why, in spite of the fact that their work does not demand it, must the engineers be refused any cuts in all classes and labs. It is true that the engineering courses

are probably harder to master than courses in other colleges. However, there is no reason to suppose that the engineers are any the less capable than their contemporaries in the other colleges to whom cuts are allowed.

There is nothing basically wrong with the idea of allowing as many cuts as there are credit hours in a course. With a system of cuts, the student is put entirely upon his own responsibility in the matter of keeping up in his work. If he takes a cut when a quiz is given in class, he automatically takes a zero in that quizz. If he falls behind in his work due to lack of attendance, it becomes evident at once in his prelims and finals. However, in the name of all that is reasonable, why must he be forced to attend each and every class when he is perfectly able to pass his prelims and finals without this forcible attendance.

It is, after all, the student who is paying for the privilege of attending the university, and as long as he is able to show by his grades that his work is satisfactory, there is no logical reason why his presence in every class should be compulsory. There need be now lowering of the College of Engineering standards with the abolishment of the compulsory attendance rule as long as the prelims are made of the same difficulty as they are present.

Why not try a system of credit-hour cuts for one term?

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MUTUAL UNDERSTANDING

In Cornell, as in other large Universities, there is maintained a rivalry and traditional lack of understanding between component colleges of the campus. The men do have common interests in the form of fraternities and other extracurricular activities, but do they appreciate the difference of outlook as fostered in each school itself. Each man's apparent eccentricities are attributed to his previous environment.

Though the majority of the men do, it is a shame that the students miss out on this most interesting phase of the University. This contrast can be easily appreciated by simply taking a course in a college other than his own. From this experience, the engineering student learns of the apparent disregard that the Arts student has for numerical accuracy and attention to details which seem so essential to the engineer. A specific example of this difference of emphasis might be found in those arts textbooks in which graphs appear, for seldom is there any differentiation made between curves for ease of reading or explanation.

Experiences of the above type serve to point out the opinion of others in the world, of ones over emphasized sides, and prepare him to predicate and plan for reactions. If the practice of taking courses in another school were more common, and understanding might be established which would do away with some of the hard feelings between schools and lead to a more broad minded student body.

SAFETY ON HIGHWAYS

The safety of the drivers on the modern highways is causing increasing interest in the design and the regulating of the speedways of the present and future. In the past the only requirement that a road had to fulfill was that of convenience and durability. The present rate of traffic flow on the roads necessitates the design of the future roads with an eye on the safety for the users as well as the cost, convenience, and service.

In the first days of the century the old type of road was quite able to carry all the traffic with little or no congestion, while the speed of traffic was so slow as to permit the use of sharp curves, steep grades, and other variations in the road that today would not be tolerated. It is to the credit of the engineer that he realized the change in conditions and set out to correct the faults of the highways.

The first thing that was done, and very ably done it was, was to design the pavements for hard, long service with especial care in respect to the alignment and surface of the thoroughfare with the results that where a decade or two ago a trip of over two hundred was a hard days trek and the thought of traveling in rainy weather was revolting, today a trip of four hundred miles is a pleasant days ride and the rain only causes a slight reduction in speed of the cars.

With the increase in speed of the traffic there came the dangers due to collision with other cars and the smashing into trees, etc., along the edges of the pavements.

These accidents are due mostly to the lack of proper warning of curves and danger spots. The first attempts to solve this problem was to place warning signs at the curves and danger spots, and for a while the results were fairly satisfactory. Then the traffic increased and the velocity of the cars increased resulting in more accidents due mainly to lack of separation of traffic. This problem was partially solved by the use of white lines on the pavement to indicate the lanes of traffic and to indicate the curves. This method was excellent except for the slippery effect of the paint when wet. There have been attempts at solving this problem and one of the most effective is that being used in the State of New Jersey on the new speedways.

This new device is simply a bit of reflecting glass encased in a metalic frame. The frame is set in the pavement being spaced about 100 ft. apart so that the glass will reflect the light of the cars. In this manner the road is separated into lanes for traffic in a clear form, there is no danger of slipping on the pavement, and there are no upkeep charges.

The simplicity of the planning of the roads and the correction of the faults just goes to show that no matter how difficult the problem may be the solution instead of being complicated is in most cases very simple.

ALUMNI NOTES

CORNELL MEN TO HEAD SOCIETY OF CIVIL ENGINEERS

Daniel W. Mead, a Cornell graduate in the class of 1884, will become president of the American Society of Civil Engineers at the 83rd annual meeting of that organization to be held in New York, January 15 to 18 inclusive.

Harry W. Dennis, who graduated from Cornell University in 1899, has been elected a vice president of the American Society of Civil Engineers and will assume office at the same meetng.

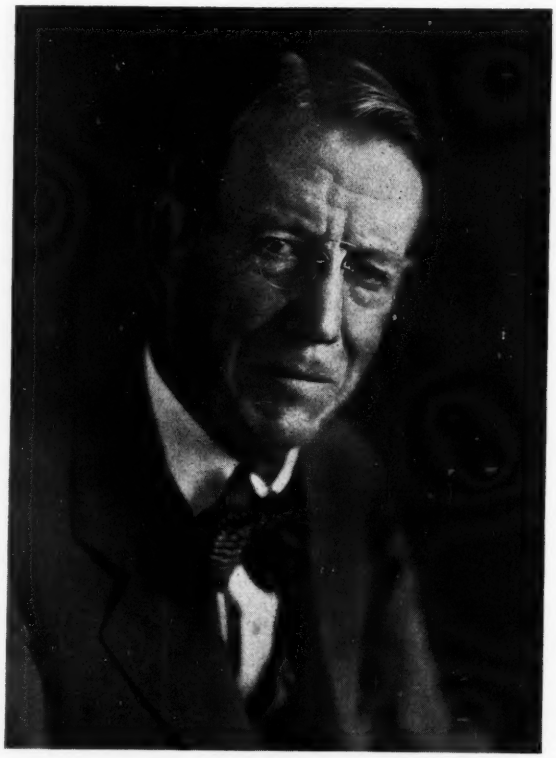
Mr. Mead entered the employ of the Federal Government following his graduation from college. From 1888 to 1896 he was chief engineer and general manager of the Rockford Construction Company. Since 1896 he has practiced as a consulting engineer on hydraulic works and power plants. For twenty-eight years, from his appointment in 1904 until his retirement in 1932, Mr. Mead was professor of hydraulic and sanitary engineering at the University of Wisconsin.

In addition to his consulting practice Mr. Mead has served on many public boards and commissions. In 1914 he was appointed a member of the Red Cross Commission to China on flood protection of the Huai River. From 1913 to 1920 he was consulting engineer to the Miami Conservancy District. He was appointed, in 1928, by President Coolidge to the Colorado River Board to pass upon the plans for the Boulder Canyon project, and is now a member of the board representing the Federal Government in connection with construction for the Chicago Sanitary District.

Mr. Mead has contributed many technical articles on engineering to professional publications. He is a member of the American Society of Mechanical Engineers, the American Water Works Association, the New England Water Works Association, the American Institute of Consulting Engineers, the Wisconsin Engineering Society, the American Institute of Electrical Engineers, and the American Association for the Advancement of Science. Mr. Mead, now to be president of the American Society of Civil Engineers, was elected to honorary membership in the Society in 1931.

Mr. Dennis secured his early experience on hydroelectric surveys and construction in New York State and the east. In 1909 he moved to Los Angeles, Calif., and entered the employ of the Southern California Edison Company. Since 1926 he has been the chief civil engineer of this Company.

Mr. Dennis is also widely known for his work in engineering research. In 1924 he was appointed a member of the committee on arch dam investigations of the Engineering Foundation, and was in charge of the construction of the Stevenson Creek experimental test dam, which later was tested to destruction.



DANIEL W. MEAD '84 C.E.

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LEADING MEMBER OF CLASS OF '22 PASSES

William F. Rippe ME '22, died August 24 at his home in West Orange, N. J., after a four month's illness. He was thirty-four years old and had risen from the rank of cadet engineer upon his graduation, to the position of planning and installation engineer in the Electric Generation Department of the Public Service Electric and Gas Company of N. J.

As an undergraduate, Mr. Rippe was one of the best-liked students on the campus. His activities included captaincy of the varsity basketball team in 1922, and memberships in Pi Kappa Alpha, Tau Beta Pi, Phi Kappa Phi, Atmos, Sphinx Head, the College Honor Committee, and the Student Council.

Mr. Rippe is survived by his wife, two children, his father, a sister and a brother.

'97 ME—At the annual meeting in New York City, November 15, of the society of Naval Architects and Marine Engineers, Frederick D. Herbert was elected one of the organization's vice-presidents.

'00 ME—Frederick B. Hufnagel, president of the Crucible Steel Company of America, has purchased the estate of Baron John von Leidersdorff on Dingletown Road, Greenwich, Conn.

'03 ME—After resigning his post as vice-president of Certainteed Products Corporation, Audenried Whittemore was elected to the newly created post of vice-chairman of the concern.

'06 ME—Howard L. Aller was announced president of the American Power and Light Company by officials of the Electric Bond and Share Company.

'11 ME—William Haag is travelling engineer for the American Arch Company of New York, a firm specializing in steam locomotive combustion. His address is 2026 Marshall Avenue, St. Paul, Minn.

'11 ME—John O. Fuchs is general superintendent of power for the Central Hudson Gas and Electric Corporation, Poughkeepsie. His address there is 50 Market Street.

'12 ME—William E. Inish is editor of Industrial Equipment News.

'13 CE—Paul Macy is assistant sales manager for the Barrett Company, New York.

'13 ME—Sterling W. Mudge will complete ten years of service to his community by retiring December 31 from his post as commissioner of finance for Glen Cove, L. I. Mudge is assistant general manager of the New York Division of the Socony Vacuum Oil Company.

'16 ME—Robert A. Anderson is vice-president of the Alexander Young Building Company in Honolulu, T. H.; he owns and operates the Alexander Young Hotel, which is a relay point for the nation wide broadcasts of the Columbia system. Anderson is also president of the Honolulu Rotary Club.

'21 ME—Francis P. Hodgkinson of the Sperry Gyroscope Company, Inc., was author of a paper "New Studies in Ship Motion" presented at the forty-third annual meeting of the Society of Naval Architects and Marine Engineers, in New York.

'24, '25 EE, '24 BS—William A. Carron, Jr. is president of the Valley Oil Company and Solar Products Company. He and Mrs. Carron (Marguerite L. Piggot) live at Warrensville, Ohio.

'24 ME—Robert J. Sloan, Jr., is advertising engineer for the Sealright Company, Fulton.

'25 EE—Edwin Sternberg married Loraine H. Mace in Pittsburgh, November 28. They will reside in New York City after a honeymoon in Bermuda. He is an air conditioning engineer for the Armo Cooling and Ventilating Corporation, New York City.

'26 CE—John R. Zehner, construction superintendent for Montgomery Ward and Co., located last month in Rock Springs, Wyoming. He specializes in the remodeling of retail stores.

'27 CE—Irene M. Moffat, one of the few women holding engineering degrees from Cornell, was married June 18 to Chester R. Longwell, professor of geology at Yale.

'27 ME—William J. Joyce, Jr., is an engineer for the Ohio Bell Telephone company, Columbus. He is president of the Cornell Club of Central Ohio, and inventor of numerous household and automotive devices.

'28 EE—Foreman for Proctor and Gamble, soap manufacturers, in their Baltimore, Md. plant, Warren Schrader lives in that city at 2731 North Calvert Street.

'28 EE, '35 PHD.—J. Albert Wood, Jr., is an instructor in Electrical Engineering at M.I.T.

'28 ME—Edward R. Fitch, Jr., married Jean Bogardes, September 24. He is employed in the advertising division of the Leeds and Northrup Company.

'29 ME, '31 MME—Frederick W. Kelly Jr., sales representative for the North American Cement Corporation in Washington, D. C., has been transferred to the Catskill plant of his company.

'30 CE—Joshua W. Run is a dispatcher for the Eastern Air Transport lines at Washington Airport, Washington, D. C.

'31 ME—Paul N. Hunt, is assistant power engineer for the Port Neches, Texas, asphalt refinery of the Texas company.

'35 EE—Employed in the tabulating machine division of the Internatioanal Business Machine Corp., James D. Tate lives at 1607 Broad Street, Endicott.

'35 ME—John Palmer is located in Baltimore, Md., as an employee of Frigidaire, Inc.

'35 C. E.—E. F. Brummerstedt writes that he is working for Babcock & Wilcox Co. of Barberton, Ohio, where he is an assistant computer and draftsman. He also reports that Sid Walzer, John Harvey, Hank Dewey, Al Wilcox, all '35 C. E., George Ashton and Walter Morris, both '35 M. E., are out there with him. Although these classmates are there with him, he still yearns for Ithaca, college life and coeds who can dance. After attending a Scabbard and Blade dance at Akron University he was advised, he says, to forget his eastern collegiate style and do "in Rome as the Romans, and in Barberton as the Barbarians."

(Ed. Note: While attending the School of Civil Engineering, Messrs. Brummerstedt, Walzer and Harvey served on the staff of the *Cornell Civil Engineer* as Alumni Editor, Business Manager, and Advertising Manager, respectively.)

COLLEGE

A.S.C.E. MEETING

At the December meeting of the A.S.C.E., a representative group of Cornell Engineering students and Faculty enjoyed an amiable personality and a clear analysis of the Tri-borough Bridge Project as set forth by Mr. Homer R. Seelye, a prominent engineer of George Washington Bridge fame and at present a member of the engineering staff of the New York City project. Mr. Seelye's concise history of the project's finances was followed by an illustrated lecture on the actual construction with its problems and their solutions. The lecture was given with the same precision and accuracy of information as was evidenced by the lecturer last Xmas when he conducted a group of Cornellians through the project. Mr. Seely again extended his invitation, and by the time this edition has gone to press, many of our boys will most likely have taken advantage of his hospitality.

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E. E. SMOKER

The Junior-Senior Electrical Engineering Smoker, sponsored by Eta Kappa Nu, the Electrical Engineering honorary society, held Friday, November 15, was very successful. It provided an excellent means for the juniors to get better acquainted with the seniors and faculty, and the affair was well attended by both faculty and upperclassmen.

W. K. Mayhew '36 and M. P. Matthew '36 entertained the gathering with several piano selections. They were followed by a speaker from the Savage Club who gave a "chalk" talk.

The principle speakers for the evening were Professors Lincoln, Malti, Burckmeyer, Chamberlain, and Karepetoff, who relaxed their usual dignity, and spoke on personal and humorous topics of general interest. A highlight of the evening was a demonstration by Professor Strong on his midget bass viol, built on a spade, concerning which many tales have been told.

Following Professor Strong's demonstration, "Gus" Winans kept the crowd in good humor until the refreshments arrived.

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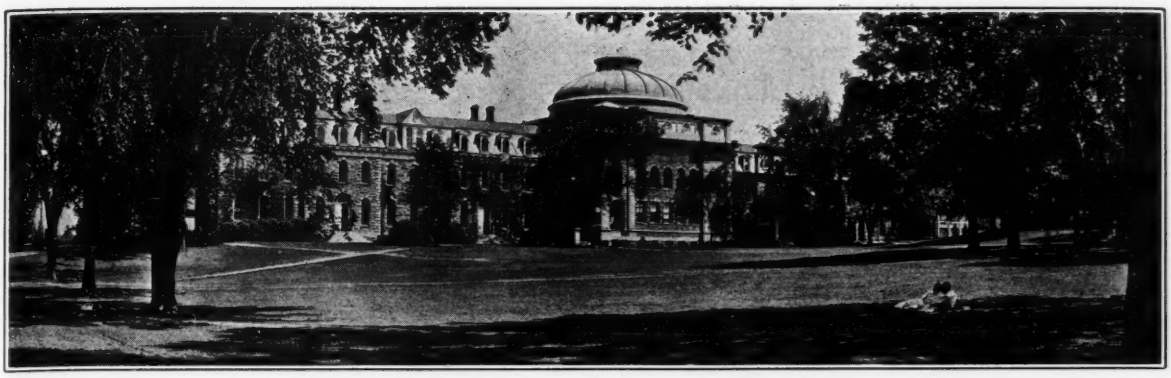
A.I.E.E. MEETING

A public meeting of the A.I.E.E. was held in Rockerfeller Hall, Friday, Nov. 22nd, at which Professor J. R. Collins, of the Physics Department, gave a demonstration of the Van de Graff electrostatic generator. Problems connected with nuclear bombardment call for high energy electrons. One means of getting these high energy, high velocity electrons is to have them fall through a large potential; another is to accelerate them by suitable use of a high frequency field. The principle of the Van de Graff machine is simply that if a charge is added to the inside of a hollow conductor, the charge accumulates on the outside of the surface, and more charge may be added. Thus a low voltage will suffice to build up a very high one, the voltage being limited by the insulation.

In the practical form of the machine demonstrated in the lecture, a belt of some type of empire cloth revolved on 8 inch drums, five or six feet apart. At the lower end of the belt, a row of points was used to "spray" the charge on the belt, and at the top, another row was used to remove them. The upper drum was inside a 2 foot sphere, used to collect the charge. Plates were so arranged to give better efficiency by removing positive charges at the same time as negative ones were added. These negative charges were obtained from a mercury arc rectifier of the usual type, giving 10,000 volts. The speaker pointed out that the negative charges give better results than do positive charges, although the reason for this is not clear.

In the demonstration, sparks 16 inches long were obtained. Under more favorable conditions, sparks 22 inches in length have been obtained, corresponding to a voltage of 400,000.

Sphere gaps were used in these measurements. When



NOTES

a rod was used, the sparks were only a few inches long. This shows the difficulties due to conduction by ionization of the air, and that the voltage is limited by this factor. If the charge is supplied at a faster rate, the voltage will increase. The limitations due to changing of flux distribution and ionization are very great. These may be overcome by the use of the machine in a high pressure atmosphere, or in a vacuum.

Prof. Collins also spent considerable time discussing the measurement of these high potentials. All of these were attended with difficulty due to the distribution of flux lines being very great near any grounded conductor placed in the field. They all tend to exaggerate the voltage obtained.

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A.S.M.E. MEETING

At the December meeting, Mr. Alex Dow, president of the Detroit Edison Company, expressed the belief that England's gigantic government controlled power distribution plan will be a success. Under this "grid" system, which was put into effect about six years ago, all of England is covered by a vast network of power transmission lines. Various power plants throughout the country feed these interconnecting lines.

One of the technical problems, discussed by Mr. Dow, was that of proper switch mechanisms to cut out a certain plant if it should breakdown. When a plant breaks down, it consumes power rather than supplying it, and this creates an enormous load on the system.

Mr. Dow is recognized as one of the world's foremost authorities on electric utilities. He was called in by the British government as consultant on the project.

Mr. J. W. Parker '08, a trustee of the university, gave a brief talk.

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E.E. GET-TOGETHERS

This Fall Professor V. Kapapetoff of the School of Electrical Engineering has again instituted his custom of having small groups of the Senior engineers at his home for informal get-togethers. Professor Kapapetoff plans a program of music, talks and dancing which combines with the spirit of the occasion to make the evenings most enjoyable.

Perhaps the most interesting thing which the professor has demonstrated this fall is his equipment for making and playing records. At the first meeting of the year the members of the group had the noval and interesting experience of making a record themselves and then playing it to themselvves. Professor Karapetoff also demonstrated records which he had made making it possible for him to play his own accompaniment on the piano while playing his chello, the piano part being played from a previously made record. The high spot of the evening was his record in which one woman sang a trio with herself, the record being made of three other superimposed records.

The School is fortunate in having a man who is interested in knowing the members of the class personally and who is able to present such delightful entertainments.

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ENGINEERS MAKE MERRY AT BALL

After careful derivation of the Equation for Social Success—with proper regard for the Sibley Constant—the Engineers decided to defy all tradition and superstition and inaugurated their contribution to the welfare of the University, on Friday, December 13, by presenting The Engineers' Ball in the Drill Hall.

The rythm was supplied by one of our maestros—Sandy Wall—while the heigh-di-ho (and incidentals) were supplied by Blanche Calloway. More than 1200 couples present enjoyed a fine evening, especially when the storm raging 'round Ithaca temporarily interrupted the lighting system.

The Ball was sponsored by four of the honorary engineering societies: Eta Kappa Nu, Kappa Tau Chi, Chi Epsilon, and Atmos. The dance committee was headed by Bud Collings, and included H. D. North, J. F. McManus, and Sandy Wall.

CORNELL SOCIETY of ENGINEERS

"The objects of this Society are to promote the Welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Column

January 1, 1936

Fellow Engineers:

Your Society is now actively undertaking to reorganize. This is the second such step, the first one being in 1919 when the original Cornell Society of Civil Engineers was expanded into the Cornell Society of Engineers, embracing all engineering graduates at the time the Sibley College of Mechanical Engineering was combined with the College of Civil Engineering and when the Schools of Civil, Mechanical and Electrical Engineering were set up.

This Society has always been national in scope with the addition of many graduates in foreign countries actively interested. However, because New York City had the largest group of alumni and also due to its proximity to Ithaca most of the activity naturally centered in New York in spite of the widespread interest throughout the country.

The present program contemplates a decentralized organization with regional groups each headed by a Vice President. The President will be elected from any one of the organized groups by the entire Society. These regional sections will be built up in Baltimore, Birmingham, Boston, Chicago, Cleveland, Detroit, Milwaukee, Philadelphia, Pittsburgh, St. Louis, Washington and other localities where members may desire to have a more active part in our proceedings.

The need for regional sections has not only been obvious for many years but has actually been attempted on two occasions. The principal hinderance has been the lack of a ready means of communication with the membership. This situation has now been rectified by the consolidation of the two separate engineering magazines into the CORNELL ENGINEER. A subscription to this magazine is included with a membership in your Society. With the major difficulty of a simple means of communication solved our scattered membership has now a definite means of becoming articulate as a whole and can participate in group activities.

One-quarter of our engineering alumni have from time to time been actively interested in the Society in spite of our lack of regional sections. Under the new plan of organization undoubtedly this proportion will be materially increased. Lack of personal contact rather than lack of interest has been the real hinderance to the growth of membership. Our professors are glad to attend gatherings of alumni, discuss the latest campus news and developments first hand. Those who attend are well repaid and derive great satisfaction and enjoyment from the informal discussions which develop, and next to a trip to Ithaca revive the memories of student days and contrast the campus atmosphere then and now. In addition to the social side there is a reawakening of the bond between the graduate and his college and a renewed inspiration infused into faculty members by such contacts with former students.

These regional groups will form tangible evidence of the alumni interest in their college and be very helpful in their reactions on the efforts of the faculty. After all the normal person derives his greatest satisfactions from mutual interest and this is particularly true of those who attended the same school. Why not conserve and foster the fellowship and loyalty based on these associations in an organization whose primary purpose is to enhance the reputation of your Engineering College and its graduates?

Very sincerely,

EDWARD C. M. STAHL,
President

Back of a Medal

FIRE was raging through a Virginia village at midnight. A telephone workman sped there from his home . . . found the central office in danger.

Relieving the young woman operator, he handled all calls . . . summoned help from nearby towns . . . 'til buildings on both sides collapsed and the telephone building caught fire. Quickly he disconnected the small switchboard . . . moved it to safety . . . improvised a telephone station in a field.

In 20 minutes he re-established communication. Next morning, the rescued switchboard was installed in new quarters . . . telephone service was resumed as usual.

That telephone man received the Vail Medal . . . one of several awarded each year to Bell System employees for outstanding public service. Devotion to duty . . . day by day as well as in emergencies . . . has given America the world's finest telephone system.

BELL TELEPHONE SYSTEM

Machine Tools

(*Continued from page eighty-seven*)

"Turret Top" of some of our present automobiles. When equipped with the new Keller Control they truly become human in what they do and far more accurate and quick. Much could be told about this important industrial process but space here will not permit.

Grinding is probably best explained by comparing it with the theory of milling carried to the ultimate. Here we have practically an infinite number of cutting edges in the form of abrasive, coming successively in contact with the work, each individual particle removing a small quantity of the material similar in theory at least to milling. This operation has been confined mainly to flat and circular surfaces but more recently has been applied to various complicated conditions. The grinding of the spiral bevel gear on the New Gleason grinder probably represents the latest development in this connection. To most of us creating a machine whose grinding wheel could follow the complicated contour of a spiral bevel gear would probably present insurmountable difficulty. But after the Gleason Company had mastered this they found that it was difficult to get the coolant to the work to prevent local heating of the work and thereby destroying its properties. So to remedy this they imparted an oscillating motion to the spindle of the grinding wheel itself. Most all of our heat treated gears today have to have a finish grind to bring their contours into the required shape, accurately.

Planing and shaping is, as the name indicates, the removal of metal along a plane surface. In the former case the work is carried on a movable table so that the work carried thereon can be brought into contact with cutting tools so mounted as to work on the three exposed sides if it is necessary. In some cases we might find two heads mounted on the horizontal cross rail and thus two simultaneous cuts can be made upon the top side. Of course on the return stroke there is no work being done on the piece and although quick return devices have been employed there is a loss of approximately 25% in cutting time. To reduce this, there has been introduced recently to the market, planers with opposed heads mounted back to back on the horizontal cross rail, so that both strokes of the table are utilized for cutting.

In the shaping operation the work is held stationary and the cutting tool caused to pass back and forth across the work in the desired fashion. The shaper is adapted to the same type of work as the planer but used on smaller work.

Broaches have been used for a number of years for the finishing of holes. There is nothing new in the theory of the process but considerable stride has been made of late in adapting this process to operations long reserved for the milling machine. A Broach is nothing more than a milling cutter unrolled or developed. It is in bar form with a series of cutting edges each one projecting slightly beyond its neighbor. As the bar is pulled across or through the work each successive tooth removes its proportion of the work. The first teeth on the bar are low and short and as they progress along the length of the bar their height is increased in proportion to the amount of material that it is desired to remove. The short stubby teeth are used to remove the heavy cuts of the metal while the long teeth near the end of the bar are used as the finishing cuts. Here in one operation we can take the roughing and finishing cuts and maintain a very accurate and smooth surface comparable to milling. Broaching is superior to reaming in irregular holes because it is impossible to get a reamer in other than a round hole and, too, a broach will hold its size longer than a reamer, thereby insuring greater accuracy. The broach will machine many more pieces per grind than any other form of cutter. However the Milling Machine people are very quick to point out that when grinding is necessary there is a much longer time required in the grinding operation. Space does not permit to go into details of broaching but it is sufficient to say that recently it has become increasingly popular.

Drilling is an intensely interesting operation for provision not only has to be made to cut the metal but also the flutes have to be sufficiently large to accommodate the removal of the chips as they are formed and also furnish means for getting the coolant to the point of the tool. In large drilling operations where the drill is of considerable length it is necessary to have a hollow drill with the coolant supplied through the center of the drill. In modern drilling operations the heat treatment and grinding of the drill has to be held pretty closely for a satisfactory job. Considerable progress has been made in making the machines more powerful with geared spindles and quick change clutches enabling the operator to go from one speed to another in almost one motion. The progress in radial drills probably has been more outstanding. The center column has been increased in size to give greater stiffness and therefore improved accuracy. Radial drills consists of a large center column with a cantilever rail mounted to the column by a split collar. On the cantilever rail there is mounted a movable head carrying the drill spindle. With this arrangement it gives a freedom of operation in all directions without disturbing the work. In the modern radial all these rails and heads are power operated either through push button control or lever action. This all gives to the operator a very quick and accurate control. This type of drill is in considerable demand at the present.

The last in this series, Honing, is distinctly a finishing operation even more so than grinding. The present state

of the art is a relatively new development since 1922 and it is due to this operation that our automobile "break in speeds" have been gradually rising until the dealer now cautions not to drive over "sixty." A Hone generally consists of a number of stones (generally 6 for diameters in excess of 3") rectangular in cross section with the thickness of the stone about ⅛" and the length up to 2 or 4 inches. These stones, especially prepared for the desired operation, are held in metal shoes mounted upon a central cone longitudinally adjustible and controlled by a micrometer head so they can be set to the desired dimension. These tools will remove a taper from a cylinder and finish it to the true circular form within a few ten thousandths of an inch. Generally kerosene is supplied as the lubricant.

The old honing operation used to be a time consuming process, but in the modern power driven hone the tool has imparted to it a rotating motion as well as an occillating motion. With approximately .003" of cast iron to be removed in a well reamed or finished bored cylinder, the modern hone will operate at a rotating lineal speed of approximately 225 f.p.m. with stroke speed 60 to 79 f.p.m. and can quickly finish it to an accuracy within .0005".

As for development in the Industry, it is always difficult and dangerous to predict, but there are a few things that stand out that might be worth mentioning. We have progressed to within about 90% of the hardness of the diamond in our cutting tools. Of course some day, some one will be able to develop a diamond inserted tool that will withstand the rough usage without too much danger of breakage and we will then have arrived at the ultimate. Remember, however, when we have a tool we have to have a method of sharpening it which according to our present methods requires something slightly harder. Some of our carbide tools were limited at first in their usefulness because it was not until we developed the diamond impregnated wheel were we able to satisfactorily grind these tools, so it does not look as though there is much to be gained in this direction.

Probably more progress will be made in the art of metal removal when more fundamental studies are undertaken as to the nature of the tool action and the behavior of the metal while it is being cut and it is encouraging indeed to find some of that research in progress now.

In conclusion as for opportunities in the Industry I have already pointed out that the Industry is seriously undermanned. There is in my opinion a very excellent opportunity for technically trained men in this field, for as a rule they are scarce. After one has served his apprenticeship and established himself in the Machine Tool Industry there is always the chance of going into general Industry with the entree of the Machine Tool Industry behind one, for general Industry draws on this industry for its more important manufacturing jobs.

STRESS and STRAIN

The following story was written by D. B. Steinman, president of the New York State Society of Professional Engineers. It has been reprinted widely, so you may have seen it—but we include it here as part of the department's super-service to readers. Read it to your Arts room-mate next time he starts razzing you about culture and stuff.

THE ENGINEER—A PARABLE

One day three men, a lawyer, a doctor, and an engineer, appeared before the angel St. Peter as he stood guarding the Pearly Gates.

The first man to step forward was the lawyer. With confidence and assurance, he proceeded to deliver an eloquent address which left St. Peter dazed and bewildered. Before the venerable Saint could recover, the lawyer handed him a writ of mandamus, pushed him aside, and strode thru the open portals.

Next came the doctor. With impressive and dignified bearing, he introduced himself, "I am Dr. Brown." St. Peter received him cordially. "I feel I know you, Dr. Brown. Many who preceeded you said you had sent them here. Welcome to our city!"

The engineer, modest and diffident, had been standing in the background. He now stepped forward. "I am looking for a job," he said. St. Peter wearily shook his head. "I'm sorry," he replied, "we have no work here for you. If you want a job, you can go to Hell." This response sounded very familiar to the engineer, and made him feel more at home. "Very well," he said, "I have had Hell all my life and I guess I can stand it better than the others." St. Peter was puzzled. "Look here, young man, what are you?" "I am an engineer," was the reply. "Oh yes, do you belong to the Locomotive Brotherhood?" "No, I am sorry," the engineer responded apologetically, "I am a different kind of engineer." "I do not understand," said St. Peter, "What do you do?" The engineer recalled a definition and calmly replied, "I apply mathematical principles to the control of natural forces." This sounded meaningless to St. Peter and his temper got the best of him. "Young man," he said, "you can go to Hell with your mathematical principles and try your hand on the natural forces down there." "That suits me", the engineer responded, "I am always glad to go where there is a tough job to tackle." Whereupon he departed for the Nether Regions.

It came to pass that strange reports began to reach St. Peter. The Celestial denizens, who had amused themselves in the past by looking down on the less fortunate creatures in the Inefrno, commenced asking for transfers to that domain. The sounds of agony and suffering were stilled. Many new arrivals, after seeing both places, selected the Nether Regions for their permanent abode. Puzzled, St. Peter sent messengers to visit Hell and to report back to him. They returned all excited and reported.

"The engineer you sent down there," said the messengers, "has completely transformed the place so you would not know it now. He has harnessed the Fiery Furnace for light and power. He has cooled the entire plcae with artificial refrigeration. He has drained the Lake of Brimestone and has filled the air with cool, perfumed breezes. He has flung bridges across the Bottomless Abyss and has bored tunnels thru the Obsidian Cliffs. He has created paved streets, gardens, parks and playgrounds, lakes, rivers, and beautfiul water falls. The engineer you sent down there has gone thru Hell and has made it a realm of happiness, peace, and industry."

* * *

Carl Neigel certainly has his troubles—we wonder how many other engineers are bothered in the same way. Carl appeared in class one morning with those beautiful blond waves cut real short. We asked why the haircut, and he told us the tragic reason—"Aw, I had to—women were always running their fingers thru it."

* * *

When Prof. Switzer first met his mechanics class after returning from a trip to New York, he was given a decidely icy reception. You'd better watch that, Gerry . . .

* * *

You all who went South for warmth and sunshine this vacation will remember the blizzard. South Carolina had the toughest time—20 inches snow in some places, traffic paralized, highways blocked. A hasty conference of the high officials was called, and after great deliberation, a bulletin was issued—the state was sure it had one snowplow, but it couldn't remember where it was.

* * *

Prof. Sawdon explained to his class that a thin layer of asbestos on furnace pipes increases instead of decreases the heat loss from the pipes. Then why, he wanted to know, was this asbestos used? The class was stumped for a while, but not Andy Pierce. He volunteered the theory that it is used "to kinda ease the shock when you bump your head."

* * *

We have some real ducky items about some of the professors, but they'll have to wait for a later issue. Just before finals, we can be terribly diplomatic.

G-E *Campus News*

LIGHT READING

It has won a prize, but you will not find it in the bookstore. The movie rights will not be sold; it will, alas, never be a best seller.

The title is: Non-Riemannian Dynamics of Rotating Electrical Machinery; the author: Gabriel Kron, University of Michigan, '24, G-E engineer. The award is the first prize of the George Montefiore Foundation of the University of Liege, Belgium—10,000 Belgian francs.

Tastes in literature differ; Gabriel Kron's preferences run to higher mathematics. Some years ago, he went on a walking tour around the world, and he took with him for light reading a book full of integral signs, tensors, matrix transformations, and elliptic functions. Instead of the usual souvenirs, he brought back the material for the paper that won him the Belgian prize. He also reports that the total cost of the trip was only $200! It suggests a tip for those who have trouble with padded hotel bills. Try carrying a calculus book on your travels!

SECOND SIGHT

The complete electric man is being built piecemeal. Electric eyes and ears came first, and loud-speakers with electric vocal cords. Now comes the machine with a memory and the gift of second sight. It has been developed by G-E research scientists to study the causes of failure of electronic tubes.

Something unusual happens in a tube. It is all over in a few hundredths of a second. Then, when peace has settled down, a camera shutter clicks and records on the film the story, not only of the disturbance and its aftermath, but of the events that led up to the disturbance.

Two modern devices make this possible: the cathode-ray oscillograph and the thyratron. The oscillograph is on the job, day and night, tracing on its fluorescent screen the history of the faithful operation of the tube. Then, unexpectedly, after months have elapsed, perhaps in the wee hours of the morning, the tube goes haywire. The disturbance sets off the thyratron tube which, in turn, trips the camera shutter, The disturbance has been over for a fiftieth of a second, but the trace still lingers on the oscillograph screen, and is photographed. No longer need the scientist hover anxiously over his apparatus. He can lie comfortably in his bed, knowing that the prerecording oscillograph will remember all that happened during the night and tell him about it in the morning.

CHINA CLIPPER

The Pan-American *China Clipper* which recently inaugurated trans-Pacific mail and passenger service in its epoch-making flight from California to the Philippines and back, carries several aids to flight which have been developed by General Electric especially for aviation service.

Each of the giant ship's four 830-hp Pratt & Whitney Twin Wasp engines is equipped with built-in G-E superchargers. Complete sets of G-E electric tachometers and electric oil-temperature gauges help the engineering officer at his post in the first compartment to check on the performance of the engines.

96-218DH

GENERAL ELECTRIC